



# ENVIRONMENTAL RESEARCH BRIEF

## Pollution Prevention Assessment for a Manufacturer of Wooden Cabinets

Harry W. Edwards\*, Michael F. Kostrzewa\*,  
and Gwen P. Looby\*\*

### Abstract

The U.S. Environmental Protection Agency (EPA) has funded a pilot project to assist small and medium-size manufacturers who want to minimize their generation of waste but who lack the expertise to do so. In an effort to assist these manufacturers Waste Minimization Assessment Centers (WMACs) were established at selected universities and procedures were adapted from the EPA *Waste Minimization Opportunity Assessment Manual* (EPA/625/7-88/003, July 1988). That document has been superseded by the *Facility Pollution Prevention Guide* (EPA/600/R-92/088, May 1992). The WMAC team at Colorado State University performed an assessment at a plant that manufactures wooden kitchen and bathroom cabinets. Components purchased from vendors are prepared for production through cutting, sanding, and routing operations. Stain, sealer, and top-coat are applied in separate spray booths. After the final coating, the components are dried and assembled. The assessment team's report, detailing findings and recommendations, indicated that paint sludge from the spray booth water curtains is generated in a large amount and that significant cost savings could be achieved by dewatering the sludge before it is shipped offsite for disposal and reusing the water.

This Research Brief was developed by the principal investigators and EPA's National Risk Management Research Laboratory, Cincinnati, OH, to announce key findings of an ongoing research project that is fully documented in a separate report of the same title available from University City Science Center.

### Introduction

The amount of waste generated by industrial plants has become an increasingly costly problem for manufacturers and an additional stress on the environment. One solution to the problem of waste generation is to reduce or eliminate the waste at its source.

University City Science Center (Philadelphia, PA) has begun a pilot project to assist small and medium-size manufacturers who want to minimize their generation of waste but who lack the in-house expertise to do so. Under agreement with EPA's National Risk Management Research Laboratory, the Science Center has established three WMACs. This assessment was done by engineering faculty and students at Colorado State University's (Fort Collins) WMAC. The assessment teams have considerable direct experience with process operations in manufacturing plants and also have the knowledge and skills needed to minimize waste generation.

The pollution prevention opportunity assessments are done for small and medium-size manufacturers at no out-of-pocket cost to the client. To qualify for the assessment, each client must fall within Standard Industrial Classification Code 20-39, have gross annual sales not exceeding \$75 million, employ no more than 500 persons, and lack in-house expertise in pollution prevention.

The potential benefits of the pilot project include minimization of the amount of waste generated by manufacturers, and reduction of waste treatment and disposal costs for participating plants. In addition, the project provides valuable experience for graduate and undergraduate students who participate in the program, and a cleaner environment without more regulations and higher costs for manufacturers.

\* Colorado State University, Department of Mechanical Engineering.

\*\* University City Science Center, Philadelphia, PA.

## Methodology of Assessments

The pollution prevention opportunity assessments require several site visits to each client served. In general, the WMACs follow the procedures outlined in the EPA *Waste Minimization Opportunity Assessment Manual* (EPA/625/7-88/003, July 1988). The WMAC staff locate the sources of waste in the plant and identify the current disposal or treatment methods and their associated costs. They then identify and analyze a variety of ways to reduce or eliminate the waste. Specific measures to achieve that goal are recommended and the essential supporting technological and economic information is developed. Finally, a confidential report that details the WMAC's findings and recommendations (including cost savings, implementation costs, and payback times) is prepared for each client.

## Plant Background

This plant manufactures wooden kitchen and bathroom cabinets. It operates 2,200 hr/yr to produce about 150,000 cabinets annually.

## Manufacturing Process

Most of the cabinet doors and components used in producing the cabinets are received pre-cut from outside vendors. Other components are sent to a preparation area where they are cut, sanded, and edged. Components are then stored until needed on the painting line.

Employees use a printout of the day's scheduled production to send the correct components to the painting area in the proper order and quantity. First, the parts are sent by conveyor to a staining booth that uses air-assisted airless spray guns that rotate and coat the components on one side as they are passed through the booth. After exiting the booth the parts are flipped over and sent through a second staining booth where they are stained on the other side. Overspray is captured by a water curtain, and solvents are allowed to evaporate.

Next the components travel to another spray booth for sealer application. The sealer booth uses air-assisted airless guns to spray one side of the components. Again, overspray is captured by a water curtain. The parts then travel to a final painting booth for top-coat application. Overspray is collected in the same manner as in the other booths.

After the final coating, the components are dried in a large kiln and then sent to the assembly line. The parts are glued and stapled into finished cabinets, and drawers are assembled in a similar manner. The face boards are added as the cabinets move down the line. The cabinet doors are pre-hinged and then fastened to the cabinets. Assembled cabinets are inspected and shipped.

An abbreviated process flow diagram is shown in Figure 1.

## Existing Waste Management Practices

This plant already has implemented the following techniques to manage and minimize its wastes.

- Soap is used instead of lacquer thinner for cleaning the steel conveyor bands on the painting lines. Prior to the change to soap cleaning, approximately one drum of lacquer thinner was used each day for cleaning the bands.
- Used wooden pallets are recycled offsite when possible.

## Pollution Prevention Opportunities

The type of waste currently generated by the plant, the source of the waste, the waste management method, the quantity of the waste, and the annual waste management cost for each waste stream identified are given in Table 1.

Table 2 shows the opportunities for pollution prevention that the WMAC team recommended for the plant. The opportunity, the type of waste, the possible waste reduction and associated savings, and the implementation cost along with the simple payback time are given in the table. The quantities of waste currently generated by the plant and possible waste reduction depend on the production level of the plant. All values should be considered in that context.

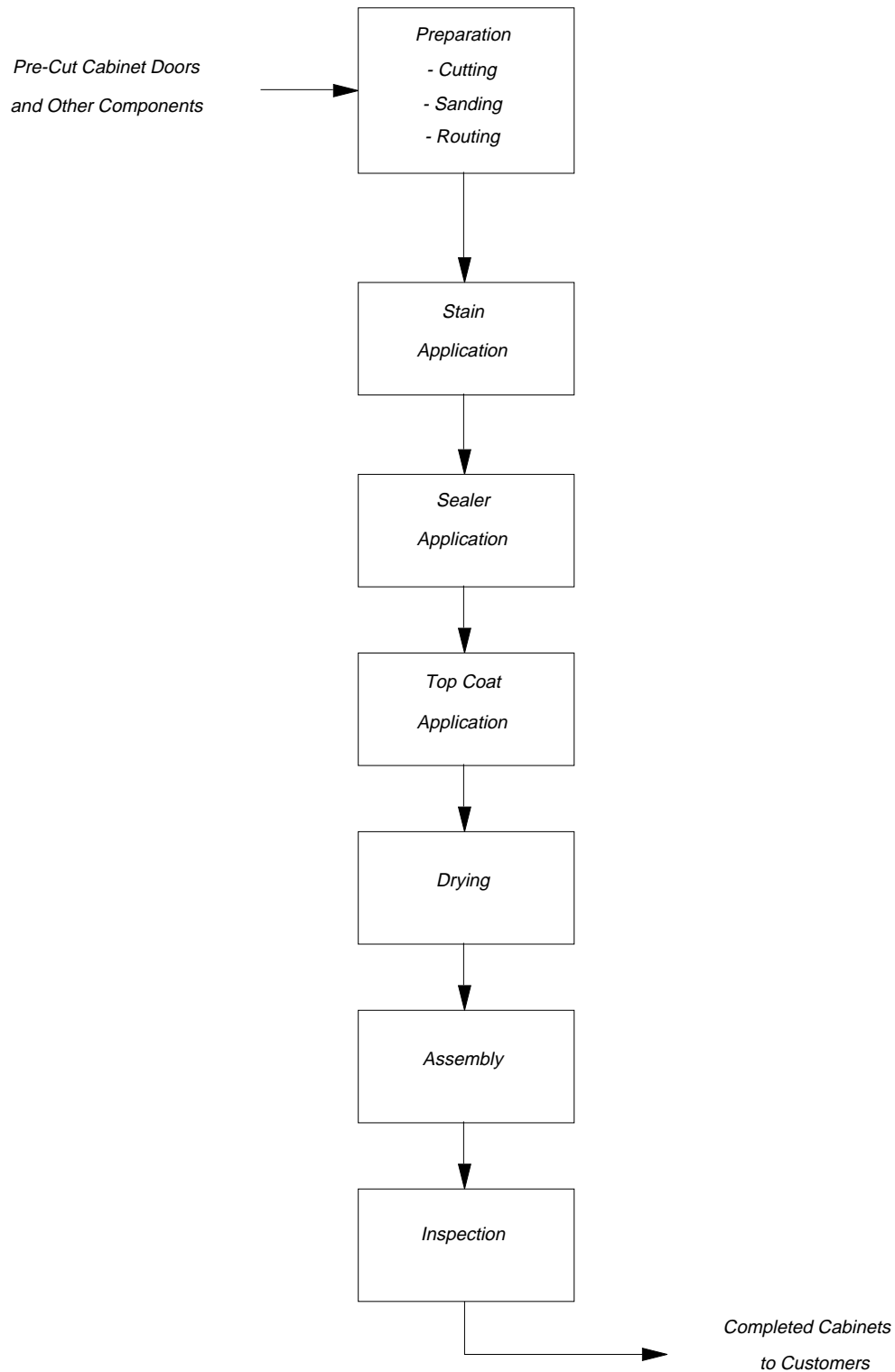
It should be noted that, in most cases, the economic savings of the minimization opportunities result from reductions in raw material and costs associated with hazardous waste treatment and disposal. Other savings not quantifiable by this study include a wide variety of possible future costs related to changing emissions standards, liability, and employee health. It also should be noted that the savings given for each opportunity reflect that pollution prevention opportunity alone and do not reflect duplication of savings that would result when the opportunities are implemented in a package.

## Additional Recommendations

In addition to the opportunities recommended and analyzed by the WMAC team, two other measures were considered. These measures were not analyzed completely because of insufficient data, implementation difficulty, or a projected lengthy payback. Since one or more of these approaches to pollution prevention may, however, increase in attractiveness with changing conditions in the plant, they were brought to the plant's attention for future consideration.

- Replace the water curtains in the paint booths with a dry filter bed for collection of overspray.
- Install air-assisted airless fine finish paint guns and paint line heaters to reduce the amount of paint overspray generated.

This research brief summarizes a part of the work done under Cooperative Agreement No. CR-819557 by the University City Science Center under the sponsorship of the U. S. Environmental Protection Agency. The EPA Project Officer was **Emma Lou George**.



**Figure 1.** Abbreviated process flow diagram for wooden cabinet manufacturers.

**Table 1. Summary of Current Waste Generation**

Waste Generated	Source of Waste	Waste Management Method	Annual Quantity Generated (lb/yr)	Annual Waste Management Cost*
Paint sludge	Water curtain in sealer and top-coat spray lines	Shipped offsite for disposal as hazardous waste	130,000	\$101,000
Evaporated lacquer thinner	Stain, sealer, and top-coat lines	Evaporates to plant air	19,030	10,010 <sup>1</sup>
Evaporated paint solvents	Spray booths	Evaporate to plant air	236,000	0
Waste lacquer thinner	Cleaning of equipment	Shipped offsite for disposal as hazardous waste	38,900	33,200 <sup>1</sup>
Miscellaneous solid waste	Various operations	Shipped offsite to municipal landfill	364,000	23,600

<sup>1</sup> Includes lost raw material value.

**Table 2. Summary of Recommended Pollution Prevention Opportunities**

Pollution Prevention Opportunity	Waste Reduced	Annual Waste Reduction		Net Annual Savings	Implementation Cost	Simple Payback (yr)
		Quantity (lb/yr)	Percent			
Install a purification system to reduce the water content of the paint sludge generated through treatment of the wastewater from the water curtains in the sealer and top-coat spray booths. Implementation of this opportunity will lead to a reduced volume of hazardous waste shipped offsite.	Paint sludge	47,000	36	\$45,070	\$9,600	0.2
Capture the lacquer thinner used for line cleaning in the paint spray booths and reuse it. Current practice is to use the thinner once and spray it into the water curtain from which it evaporates.	Evaporated lacquer thinner	9,520	50	3,880	500	0.1
Segregate waste cardboard from other solid waste, bale it, and sell it to a cardboard recycler. The resulting reduction in volume of solid waste will lead to lower landfill costs. No waste reduction will result from this opportunity.	Miscellaneous solid waste	0	—	5,670	4,600	0.8

United States  
Environmental Protection Agency  
National Risk Management Research Laboratory (G-72)  
Cincinnati, OH 45268

BULK RATE  
POSTAGE & FEES PAID  
EPA  
PERMIT No. G-35

Official Business  
Penalty for Private Use  
\$300

EPA/600/S-95/024